

The University of Chicago

HUMAN MILK STUDIES

XII. THE VITAMIN B AND VITAMIN G CONTENT BEFORE AND DURING MATERNAL CONSUMPTION OF YEAST

A DISSERTATION SUBMITTED TO THE
FACULTY OF THE DIVISION OF THE BIO-
LOGICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF HOME ECONOMICS
AND HOUSEHOLD ADMINISTRATION

1934

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EVA GRACE DONELSON

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XII. THE VITAMIN B AND VITAMIN G CONTENT BEFORE AND DURING MATERNAL CONSUMPTION OF YEAST ¹

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TWO FIGURES

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The vitamin B potency of either human or cow's milk alone may not always be sufficient for the consistent growth and well-being of the infant (Hoobler, '28; Rose, '30). Shortcomings are recognized by the appearance of symptoms in the child, varying from the loss of appetite and failure to gain in weight to the manifestation of a definite syndrome of beriberi, symbolizing the lack of the vitamin B complex. Moreover, clinical observations have shown that alleviation of these symptoms follows either the administration of this nutrient, extract of vegetable soup (Daniels, Byfield and Laughlin, '19), wheat germ sugar (Dennett, '29; Waring, '29, '31; Henricka, '32; West, '29; and Berney, '31), or, yeast (Waring, '29, '31; West, '29; Bloxsom, '29) to the infant directly or indirectly by fortification of the diet of the mother (Henricka, '32; West, '29; Brenneman, '23). Since this vitamin moiety can neither be synthesized nor stored in the

¹This study was aided by a grant from the Committee on Scientific Research of the American Medical Association and the Northwestern Yeast Company of Chicago.

²The data comprise the dissertation submitted in partial fulfillment of the requirements for the degree of doctor of philosophy in the Division of the Biological Sciences, The University of Chicago.

body to any appreciable extent, the maternal diet then must serve not only as the sole supply for maintenance and increased physiological demands of lactation, but also for the vitamin content of the milk.

Although the optimal vitamin requirement of the infant is not known in specific quantitative units, the significant fact is that dietary insufficiencies actually occur in some infants fed either with breast or cow's milk. In many of the clinical studies on human milk the diets of the mothers were known to be notably inadequate. But even the milk from women consuming diets with average amounts of the vitamin B complex has been found by biological assay to contain a relatively low concentration of this substance (Macy et al., '27). Improvement may be effected also in cow's milk formulae fed routinely in the hospital by the addition of specific vitamin adjuvants, as evidenced by the stimulation of a better appetite and increased growth in the infant. These demonstrations that the infant may experience frank dietary deficiencies with milk as the chief source of food, and that there are, no doubt, borderline conditions with symptoms yet unclassified or even unrecognized make it evident that positive means should be devised for insuring the child against alimental inadequacies during the critical period of rapid growth, thereby safeguarding not only present, but future nutritional stability.

It has been demonstrated experimentally that the maternal requirement for vitamin B is augmented during lactation (Macy et al., '27; Evans and Burr, '28; Sure, '27) from three to five times over and above that during growth. In the human mother with a failing or small milk supply, the addition of yeast and yeast preparations to the diet has been observed to promote an increased flow of milk (Waring, '31; Henricka, '32; and Wachtel, '30). On the other hand, women who were successful in the production of large quantities of breast milk experienced no greater output with supplementation of their diet, but a quantitative assay of the biological potency of the milk disclosed an improvement in its vitamin content (McCosh, Macy and Hunscher, '31). At the same

time the mothers themselves expressed a feeling of lessened fatigue with a general stimulation of well-being (Macy et al., '30).

The augmentation of the diet of the mother with yeast or yeast preparations benefits both mother and child, and since it is recognized that there are at least two well-defined water-soluble vitamins in yeast, it is pertinent to question whether each bears equal influence in the improved condition or whether one portion is more helpful than the other. Laboratory experimentation has indicated that for successful lactation and rearing of young rats, increased amounts of both the antineuritic vitamin B and of vitamin G are needed (Sure, '28). Some investigators have found a greater need for the former (Evans and Burr, '28) and others for the latter (Husseman, '31), but no study as yet has been reported on women. There are clinical observations, however, indicating that the rapidly growing infant requires larger amounts of each of these vitamins than is furnished by milk, for the feeding of accessory food in addition to the milk resulted in some cases in a promotion of growth in the infant with no increase in total food consumption (Hess, '17), in others the appetite was stimulated as well as growth, while in others the symptoms of rigidity and beriberi were mitigated. The improvement in the infant accompanying the enrichment of the maternal dietary may be due to a selective augmentation of one or the other or both of these two well-recognized vitamin constituents or to some unidentified factor in breast milk. From experimental observations in this laboratory (McCosh, Macy, and Hunscher, '31) there are indications that the fractions may be increased disproportionally. When the average diets of lactating women were supplemented with yeast, some factor promoting better utilization of food was increased in the milk. The factual evidence was demonstrated by the behavior of experimental animals in that equal or better gains in body weight were achieved on fewer calories per square meter of surface area for 24 hours during the period of maternal yeast consumption.

Since the vitamin requirement for lactation has not been measured quantitatively for woman, and there is experimental evidence to indicate that the demand for the vitamin B complex is increased at this time, further enrichment of the average dietary in this essential food component may approach a more nearly optimal food provision for both the mother and her dependent infant. By a quantitative assay of each of the constituents of this vitamin moiety passed into milk, concomitant with the supplemented maternal dietary, the ingredient which is instrumental in improving the nutritive potency of the milk may be recognized. Data derived from such an assay may aid in assuring "a more nearly perfect food for the infant," one which will supply all of the nutritive needs of the young child, thus stimulating his optimal physical progress.

The present report is a study of the effectiveness of diets rich in the vitamin B complex on the nutrition of women during lactation and on the biological potency of the milk secreted coincidentally. It includes quantitative tests on the vitamin B and vitamin G³ content of breast milk of an individual as well as of mixed milk from a group of women before and after their accustomed menus were supplemented with yeast. In addition, data are given on the relation of growth of experimental animals to the vitamin and total caloric ingesta, as well as on the composition of growth as measured by nitrogen balance studies.

EXPERIMENTAL

Subjects and breast milk. The women chosen to provide the milk for this investigation were able to secrete enough to feed their own infants and to supply for the Mother's Milk Bureau of Detroit approximately 13 ounces in excess daily. Observa-

³ The terms for the different vitamins as used in this report are defined below for clarity in discussion; vitamin B complex is the undifferentiated vitamin originally designated as vitamin B; vitamin B is the antineuritic substance for which the British use the term vitamin B₁; vitamin G is the more heat-stable substance or substances known originally as the 'Goldberger Factor' and which is specified as vitamin B₂ by the British.

tions were begun in the second or third month of lactation and extended over a period of 6 to 8 months thereafter, during which time they maintained their usual output of milk. The maternal food and liquid intakes were measured 1 week out of each month. All of the diets during the period of observation were found to be adequate according to present accepted qualitative dietary standards (Sherman, '32). The milk secreted during the period in which the women were eating their accustomed diets and that produced after 6 weeks of consumption of supplements of 10 gm. of yeast daily were tested for vitamin B and vitamin G potency.⁴ At 9 o'clock each morning the milk was manually expressed at the Bureau, and the containers sealed air tight and packed in ice until the milk was fed at 11 A.M. The yeast supplement was administered at the Mother's Milk Bureau. The infants of the women were healthy throughout the observation and made for the most part average gains of about 6 ounces per week.

For statistical interpretation and the assurance of representative growth, large numbers of test animals are required for biological assay work, consequently a greater amount of test material must be available. The quantity factor becomes more significant in testing mother's milk for vitamins B and G, since not only must large numbers of animals be maintained, but considerable amounts of milk are required for the several graded levels fed. Human mothers, as a rule, do not produce much milk in excess of that needed by their own babies, hence, in order to secure a sufficiency for reliable biological tests, pooled milk from a group of women must be used, although certain inherent complications are introduced. In view of the fact that there seems to be a direct relationship between the concentration of the vitamin B complex and the quantity of milk secreted (McCosh, Macy, and Hunscher, '31; Macy, Outhouse, and Hunscher, '28), it is of

⁴For convenience the period during which the mothers were on their usual diets will be designated as the pre-yeast period and that following and during the addition of yeast to the maternal diet as the yeast period. The vitamin G potency of 10 gm. of yeast is equivalent to 75 to 150 units, according to Sherman.

importance in a study of potency of the vitamins B and G in mixed milk, and in particular the effectiveness of dietary supplements upon the biological properties, to secure women of comparable capacities for milk production. In the mixed sample, a change in the vitamin concentration of one individual milk may be concealed by the diluting effect of the lack of change in another. This indicates the advisability of studying individual milks as a control even though it becomes necessary to use fewer samples because of the diminished quantity of available sample. In this study not only mixed milk combined under standard conditions but also the milk of an individual mother as a control was used.

Experimental animal technic. Young albino rats reared on a stock diet of whole wheat and whole milk powder (Sherman and Campbell, '24) were placed in individual cages at approximately 28 days of age and given weighed portions of the experimental basal diet which they were allowed to consume ad libitum, except in one series of studies in which the quantity was controlled. The basal diet (Chase and Sherman, '31) fed for determining the vitamin B content of milk contained casein 18, dextrin 53, autoclaved yeast 15, filtered butterfat 8, cod liver oil 2,⁵ Osborne and Mendel salt mixture 4 (Osborne and Mendel, '19); and for determining vitamin G (Bourquin and Sherman, '31) casein 18, butterfat 8, cod liver oil 2, Osborne and Mendel salt mixture 4, and dextrin 68, on which was dried an alcoholic extract of whole wheat in such proportion as to introduce the extract (80 per cent alcohol by weight) of 50 gm. of whole wheat into 100 gm. of food mixture. For the most part from six to ten standardized animals were maintained on each test level of milk over an 8-week experimental period following a period on the vitamin-free diet during which the exhaustion of the store of vitamins B and G in the animal body took place.

Only those animals that consumed all of the milk daily are included in the final averages of the weekly weight increments. It happens that the milk of some women is eaten with greater

⁵ The kindness of Arthur D. Holmes, Ph.D., of the E. L. Patch Company, Boston, in supplying the cod liver oil is gratefully acknowledged.

avidity than that of others and this distaste of some animals for the milk persists throughout the test period, thus precluding the use of these results in the final interpretation of the data. With the larger quantities of breast milk as the source of the antineuritic vitamin, diarrhea frequently occurs in contrast to almost complete freedom from this condition with analogous quantities of milk supplying vitamin G. This fact is significant and is in accord with the findings that debilitation and lessened muscular tone of the intestinal tract accompany sub-optimal intakes of the antineuritic vitamin

TABLE 1

LEVEL OF MILK	PRE-YEAST PERIOD				YEAST PERIOD			
	Number of animals	Mean weekly gain	Mean weekly basal food intake	Mean weekly gain 100 cal. food	Number of animals	Mean weekly gain	Mean weekly basal food intake	Mean weekly gain 100 cal. food
Vitamin B-free diet + mixed breast milk								
<i>Cc.</i>		<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>		<i>Gm.</i>		
10	10	2.5	28.8	1.8	6	2.7	31.5	1.6
20	10	8.5	31.4	3.4	6	7.4	36.0	3.1
25	5	8.9	28.7	3.4	7	8.7	26.3	3.6
Vitamin G-free diet + mixed breast milk								
3	10	2.0	27.3	1.4	8	2.9	30.5	1.9
5	10	2.5	26.8	1.8	8	6.0	36.0	3.2
10	10	7.8	35.3	3.6	7	7.3	35.6	3.4
20	12	11.5	44.3	3.7	7	9.6	30.3	3.9

(Rose, Stucky and Cowgill, '30; McCarrison, '21). The high concentration of lactose in mother's milk may also be a mediating factor (Macy et al., '27). Because of these vitiating conditions, tests on the antineuritic vitamin potency of human milk are less conclusive than those on the vitamin G content.

Basal diet ad libitum. Equal quantities of breast milk from women with similar production records were combined daily to form the sample of mixed milk. Individual standardized test animals were given varying quantities of milk from 10 to 25 cc. daily as the sole supply of the antineuritic vitamin in a diet otherwise complete, and 3 to 20 cc. for the vitamin G test (table 1). The smaller quantities allow for the deter-

mination of the unit growth suggested by Sherman (Chase and Sherman, '31; Bourquin and Sherman, '31) and the increased amounts permit a study of the influence of more adequate vitamin intakes.

In both the vitamin B and vitamin G studies there was a progressive increase in the growth of the test animals coincident with increased consumption of milk as a source of these vitamins. This was true whether the milk was secreted by the mothers in the pre-yeast period or in the yeast period when supplements of 10 gm. of yeast were being consumed daily along with their ordinary diets.

With 3, 5 and 10 cc. of mixed milk daily as the source of vitamin G, the growth of the animals in the yeast period was equal to, or superior to, that of the pre-yeast period. The mean weekly gain of the standardized test animals over an 8-week period for the daily intakes of 3, 5, 10, and 20 cc. of mixed breast milk was 2.0, 2.5, 7.8, and 11.5 gm., respectively, for the animals in the pre-yeast period and 2.9, 6.0, 7.3, and 9.6 gm., respectively, for the yeast period. The increased gain of the animals when they were receiving milk at the lower levels from the mothers consuming a dietary supplement of yeast demonstrates that the vitamin G is carried over into the milk in appreciable quantities. These findings are further borne out by a study of the milk from an individual woman in which case the mean weekly gain in weight of animals receiving 3, 5, and 10 cc. of milk daily was 0.3, 3.4, and 7.0 gm. for the pre-yeast period and 3.6, 4.2, 7.9 gm., respectively, for the yeast period. Divergent results were at times experienced when quantities of 20 cc. of milk daily were fed for vitamin G. These inconsistencies with the higher level of milk may possibly be ascribed to the exhaustion of the store in the animal body of some yet unidentified food factors necessary for the growth of the rat as suggested by Bourquin and Sherman ('31) and hence these results may not be as reliable as those for the lesser quantities fed.

In contrast to the experiments on the vitamin G content of breast milk, the ingestion of yeast by the mothers seems to

exert no perceptible influence on the concentration of vitamin B in the milk secreted. Animals getting quantities of breast milk as high as 10 cc. daily developed polyneuritis in approximately one-quarter of the cases both before and after supplemental additions of yeast to the maternal dietary. On higher levels of milk, 20 and 25 cc. daily, results were complicated by failure to take all of the milk and also by the occurrence of diarrhea. The mean weekly gains of those animals consuming the full quota of milk daily, irrespective of other conditions, were for the animals in the pre-yeast period getting 10, 20, and 25 cc. of mixed milk, respectively, 2.5, 8.5, and 8.9 gm., and for the comparable animals in the yeast period, 2.7, 7.4, and 8.7 gm. After eliminating from the final average the gains of all animals ill-conditioned either by the failure to consume all of the milk daily or by the diarrheal condition, the resultant mean weekly gains for the remaining animals in the pre-yeast group getting 10, 20, and 25 cc. of milk daily were, respectively, 2.5, 8.8, and 10.4 gm., and for the animals in the yeast period 2.7, 9.0, and 10.6 gm. As judged by the rate of growth of rats, no discernible increase in the antineuritic potency of the breast milk herein studied was effected by the addition of 10 gm. of yeast to the maternal dietary of average vitamin content.

The weekly gain of the test animals was studied in relation to their caloric food consumption in order to further verify the growth rates of the animals in the pre-yeast vs. the yeast period, and to ascertain whether these increments were the result of a difference in the utilization of food or of an increased food intake. As based upon gain per 100 calories of food consumed, the test animals getting vitamin G from mixed milk at the lower levels manifested a noteworthy increase during the yeast period, whereas, no improvement could be recognized in those animals having milk as a source of vitamin B (table 1). These findings are confirmatory of the results of a previous study in this laboratory (McCosh, Macy, and Hunscher, '31) in which a more efficient use of food was similarly observed in experimental animals receiving breast

milk secreted during the addition of yeast to the diet of lactating women. The present study demonstrates that this improvement was due to the augmentation of the vitamin G fraction.

With enrichment of the maternal diet with 10 gm. of yeast daily, there occurred an increase in the vitamin G content of the breast milk, but there was no detectable improvement in the vitamin B potency. The vitamin G content was approximately 0.2 unit per cubic centimeter and the vitamin B concentration 0.1 unit per cubic centimeter before the supplementation of the mother's diet, but after the maternal consumption of yeast the concentration of vitamin G in the milk was increased to 0.3 unit per cubic centimeter. The specific causal factors for the disproportionate improvement in these biological components of the milk is enigmatical, and deserves detailed investigation. From their work on cows and goats, Gunderson and Steenbock ('32) concluded that the maximum concentration of vitamin B in milk is under physiological control, for when the content of this vitamin in the ration was increased from a reasonably good level to approximately 66 per cent more by the addition of yeast and wheat germ, the concentration of the antineuritic factor in the milk was unchanged. A similar interpretation may be applicable to the observed constancy of the vitamin B potency of human milk.

Controlled intake of basal diet. From the growth studies in which the basal food was consumed ad libitum, it was apparent that gain in weight of the experimental animals, although primarily influenced by the quantity of vitamin fed, varied somewhat with the amount of basal food consumed (table 1). Variability in the quantity of basal food intake is inherent in an experiment in which the food is fed ad libitum and which factor Irwin, Nelson et al. ('30) have found to bear a significant influence on total gain in body weight. For this reason a series of observations with two groups of rats of ten each were conducted on the vitamins B and G content of the milk of an individual mother fed at 5 and 15 cc. levels daily before

and during the addition of yeast to her diet in which the total caloric allowance of food for the test animals during the yeast period was maintained at the same level per gram of body weight as during the pre-yeast period. The observation extended over 7 weeks, divided into a 2-week pre-yeast period followed by a 5-week yeast period. During the last 3 weeks of the latter the amount of milk supplied daily to each group of rats was increased to approximate the mean amount fed per gram of body weight during the pre-yeast period, because of the recognition that some relationship exists between body weight and the vitamin B requirement (Osborne and Mendel, '22; Cowgill et al., '32). Under these controlled conditions there was a marked acceleration in the growth of animals having vitamin G supplied by breast milk during the ingestion of yeast by the mother; whereas, the rate of gain in body weight of the animals with milk as a source of vitamin B was not significantly changed (chart 1). The yeast supplementation had been made to the mother's diet only 2 weeks prior to the experimental observations—a shorter length of time than in the other studies of this report—but even in this case there was an increase in the vitamin G potency of the milk as judged from the marked increase in gain in body weight of the test animals.

Human milk, as determined by quantitative biological tests, is a comparatively richer source of vitamin G than of vitamin B. With the same quantity of breast milk supplying each of these factors in the respective vitamin-free diets, the growth of the animals with vitamin G supplied by milk was superior to that of those with milk as the source of vitamin B (chart 2). By relating the increment in weight of each group of test rats to their food intake (gain per 100 calories of food consumed) the growth of those animals having vitamin G from breast milk surpassed that of those receiving the antineuritic vitamin from the same amount of milk irrespective of the maternal dietary (table 1). The mean weekly gain in body weight per 100 calories of food intake of the animals with 10 cc. of breast milk daily as a source of vitamin B was 1.8 gm. in contrast

to a gain of 3.6 gm. in those rats with milk as a source of vitamin G; the gains during the yeast period were 1.6 and 3.4 gm., respectively. With 20 cc. of breast milk daily supply-

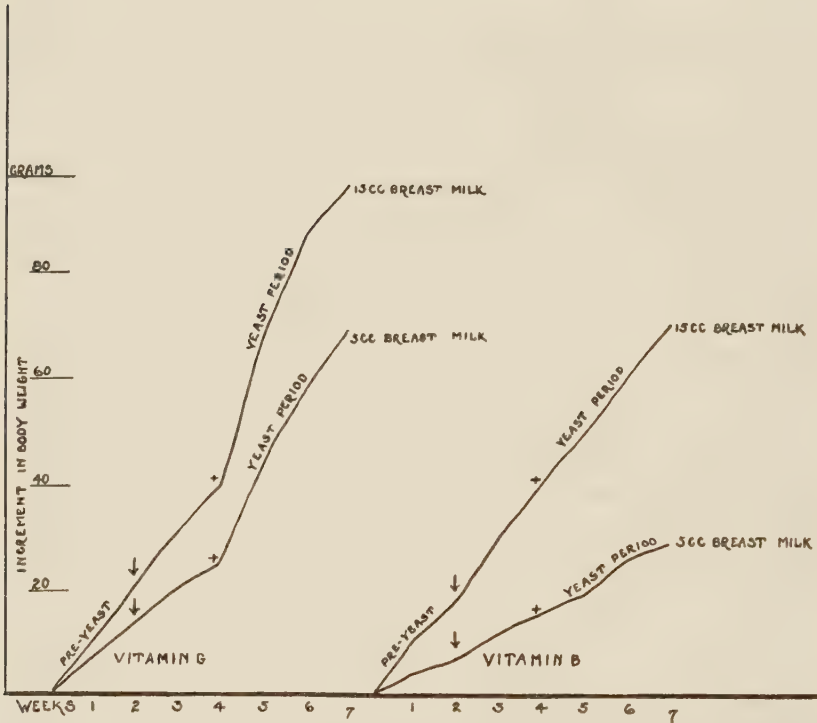


Chart 1 This chart illustrates the average gain in weight of groups of test rats maintained on an approximately constant caloric food intake per gram of body weight with 5 and 15 cc. of milk daily per rat from an individual woman as the source of vitamins B and G in a diet otherwise complete during the pre-yeast period and the equivalent amounts in terms of grams of body weight to compensate for the increased size of the animal during the yeast period. The arrow indicates the introduction of 10 gm. of yeast daily into the maternal diet.

ing vitamins B and G, the mean weekly gains of experimental animals per 100 calories of food consumed were 3.4 and 3.7 gm., respectively, during the pre-yeast period and 3.1 and 3.9 gm., respectively, during the yeast period.

A quantitative comparison of the vitamin B and G content of breast milk is possible by ascertaining the amounts of milk required as a source of each of these vitamins to support unit growth (an average gain of 3 gm. per week for 8 weeks). As a source of vitamin B, 10 cc. of milk gives an average gain in weight per the unit rate in the experimental animals during

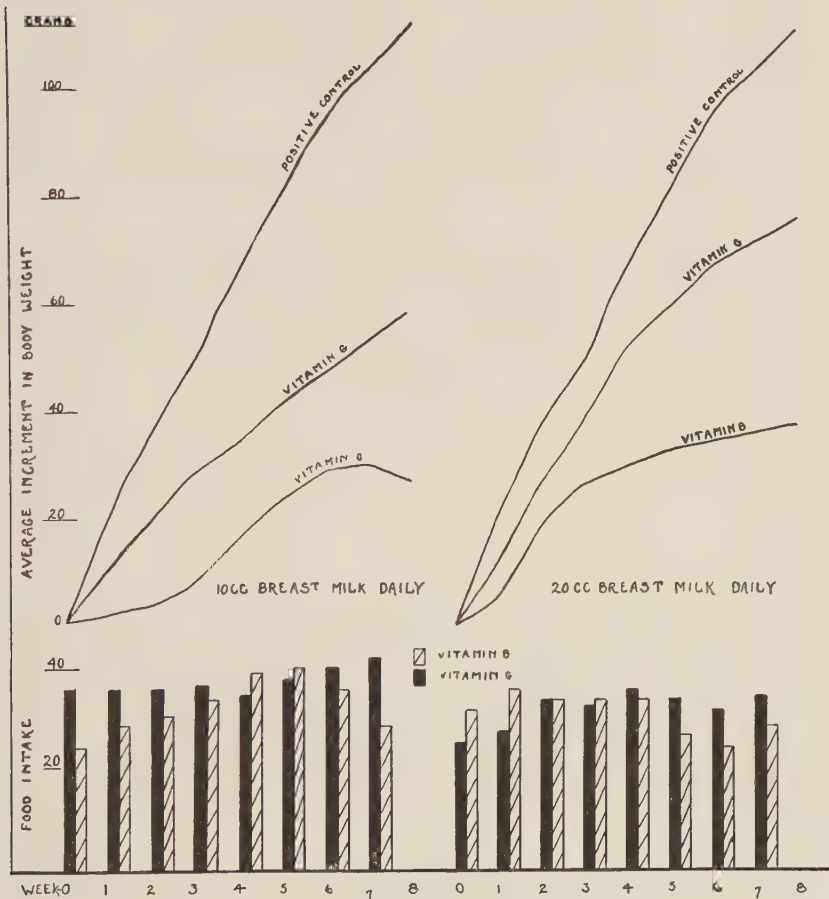


Chart 2 This chart compares the vitamin B and G potency of breast milk. In neither case, however, did the animals receiving as much as 20 cc. of milk daily per rat grow as satisfactorily as the positive controls. The animals consuming milk as the source of vitamin B ate somewhat less basal food than those in the vitamin G test.

both the pre-yeast and the yeast period, despite the occurrence of polyneuritis in approximately one-quarter of the cases, whereas, only 5 cc. daily are required for unit growth in the vitamin G test animals before supplementation of the maternal diet, and only 3 cc. after the introduction of yeast into the diets of the mothers.

Composition of growth of animals. Since the composition of growth is known to be variable, it seemed pertinent to investigate the type of gain in weight made by test animals receiving vitamins B and G from breast milk secreted before and during enrichment of the maternal diet in these factors. By means of 7-day nitrogen metabolic balance observations,

TABLE 2
Retention of nitrogen in per cent of intake

WEEK	VITAMIN B-FREE DIET + MILK				VITAMIN G-FREE DIET + MILK					
	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
1	21	39	37	43	42	65	29	61	42	57
2	31	40	24	44	54	57	30	58	54	50
			No							
3	Loss	46	balance	47	43	49	35	55	43	54
4	Loss	38	9	33	38	42	33	48	38	44
5	14	46	11	34	37	41	35	53	37	43
Mean	22	42	20	40	43	51	32	55	43	50

the milk of an individual woman was studied over 5 continuous weeks while the mother was on her usual dietary, and followed by a study of a similar period when she was consuming 10 gm. of yeast daily. Each animal of the latter period was matched as to weight with an animal of the pre-yeast period and was fed both basal food and vitamin in the same proportion per gram of body weight. Two pairs of animals were observed for the vitamin B test and three pairs for the vitamin G comparison. In all cases a greater per cent of the nitrogen intake was retained by the animals receiving milk from the mother during her period of yeast consumption (table 2). Conservation of the ingested nitrogen was accomplished by a lessened urinary nitrogen excretion (table 3) with no consistent

changes occurring in the fecal nitrogen as indicated by the coefficient of digestibility. The mean nitrogen retentions for each gram of gain in body weight for the paired animals in the pre-yeast period and those in the yeast period getting vitamin B from milk were 20.0 and 28.0 mg., 30.0 and 35.0 mg., respectively, and for those fed milk as a source of vitamin G, 34.0 and 38.0 mg., 31.0 and 39.0 mg., and 34.0 and 39.0 mg., respectively. The composition of the growth of the test animals receiving breast milk as the source of vitamin G was of higher nitrogen content during both the pre-yeast and the

TABLE 3
Excretion of nitrogen in urine in per cent of intake

WEEK	VITAMIN B-FREE DIET + MILK				VITAMIN G-FREE DIET + MILK					
	Control	Experi- mental	Control	Experi- mental	Control	Experi- mental	Control	Experi- mental	Control	Experi- mental
1	64	48	46	39	49	25	60	30	49	31
2	52	51	58	35	35	34	56	29	35	38
3	78	45	63	34	47	39	51	34	47	36
4	82	48	70	45	49	44	53	40	49	44
5	60	55	66	49	50	45	51	36	50	46
Mean	67	49	61	40	46	37	54	34	46	39
Coefficient of digestibility	77	87	81	80	89	88	87	89	89	89

yeast period than that of the animals consuming a like quantity of milk for vitamin B.

Since it has been demonstrated that enrichment of the maternal dietary confers added nutritive properties to the milk, it is of interest to know the simultaneous effect that occurs in the metabolism of the mother. Nitrogen balances of lactating women determined in this laboratory before and during the supplementation of their usual diets with yeast indicated that enhancement in the biological properties of the milk did take place (McCosh, Macy, and Hunscher, '31) and in some cases was accompanied by improved storage of nitrogen by the mother herself (Hunscher et al., '33).

SUMMARY

1. Individual and mixed samples of breast milk from women with approximately the same milk flow and on apparently satisfactory dietaries were tested biologically by means of several different controlled methods for their vitamin B and vitamin G potency before and during the supplementary additions of 10 gm. of yeast daily to the accustomed maternal dietary.

2. In both the vitamin B and vitamin G studies there was a progressive increase in the growth of the test animals simultaneously with increased consumption of breast milk. This was true whether the milk was secreted during the pre-yeast period or the yeast period.

3. The concentration of vitamin G in breast milk was increased from 0.2 unit per cubic centimeter during the pre-yeast period to 0.3 unit during the yeast period; an increase of approximately 0.1 unit per cubic centimeter, by the addition of 10 gm. of yeast to the maternal diet for the milk tested.

4. As judged by the rat growth rate method, no increase in the antineuritic potency of breast milk occurred under yeast therapy. The concentration of approximately 0.1 unit of vitamin B per cubic centimeter of breast milk remained unchanged.

5. By a series of observations in which the caloric food consumption of the experimental animals was controlled, further evidence was given that the vitamin G concentration is increased, but that no change occurs in the vitamin B content of breast milk with this enrichment of the maternal diet.

6. Nitrogen metabolic balances on test rats receiving vitamins B and G from breast milk, before and after the addition of yeast to the maternal diet, showed a greater retention of nitrogen during the latter period in all animals. The composition of the growth of the animals with vitamin G from breast milk was higher in nitrogen content than the growth of the animals with vitamin B supplied by equal quantities of milk.

7. From the observations on the women of this investigation, it can be concluded that the biological potency of breast milk can be enhanced by the addition of a concentrated source of the vitamin B complex to the average dietary. At the same time, the mothers themselves experienced less fatigue and a more satisfactory feeling of well being. These studies further suggest the need for more adequate knowledge of diet for lactating women in order that an approach can be made toward a nearly optimal food provision for both the mother and her dependent infant.

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